



U.S.NRC

UNITED STATES NUCLEAR REGULATORY COMMISSION

Protecting People and the Environment

Regulatory Issue Resolution Protocol

Inaccessible or Underground Cable Performance Issues at Nuclear Power Plants

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Identification Phase

- Cable performance issues
 - Inspection Reports and LERs
 - Several inspection findings
 - Applicable to multiple plants

- Process the issue for screening in accordance with RIRP

Screening Phase

<u>Screening Criteria</u>	<u>Weight</u>	<u>Range of Priority Values</u>	<u>Screening Values</u>
Relative safety significance	3	2	6
Relative risk significance	2	2	4
Industry resource availability	1	1	1
NRC resource availability	1	-1	-1
Compliance issue?	3	1	3
Operability issue?	2	1	2
Shutdown issue?	3	0	0
Cost-Benefit	1	1	1
Degree of complexity	2	0	0
Degree of initial consensus	1	0	0
Scope of applicability	2		2
Subjective criteria?	N/A	N/A	
Total			18



Screening Phase – Cont. Proposed Changes

<u>Screening Criteria</u>	<u>Weight</u>	<u>Range of Priority Values</u>
Potential safety significance	3	High = 2; Medium = 1; Low = 0
Potential risk significance	3	High = 2; Medium = 1; Low = 0
Industry resource availability	1	Now = 1; Later = -1 Yes = 1; No = -1
NRC resource availability	1	Now = 1; Later = -1 Yes = 1; No = -1
Compliance issue?	1	Yes = 1; No = 0
Operability issue?	1	Yes = 1; No = 0
Shutdown issue?	1	Yes = 1; No = 0
Cost-Benefit	1	High = 2; Medium = 1; Low = 0**
Degree of complexity	2	High = 1; Low = 0
Degree of initial consensus	1	High = 1; Low = 0
Scope of applicability	2	Delete
Subjective criteria?		Delete



Screening Phase – Cont. Evaluated with Proposed Criteria

<u>Screening Criteria</u>	<u>Weight</u>	<u>Range of Priority Values</u>	<u>Screening Values</u>
Potential safety significance	3	2	6
Potential risk significance	3	2	6
Industry resource availability	1	1	1
NRC resource availability	1	-1	-1
Compliance issue?	1	1	1
Operability issue?	1	1	1
Shutdown issue?	1	0	0
Cost-Benefit	1	1	1
Degree of complexity	2	0	0
Degree of initial consensus	1	1	1
Scope of applicability	N/A	N/A	N/A
Subjective criteria?	N/A	N/A	N/A
Total			16

Evaluation Phase

➤ **Criterion for Evaluation**

- **Screening value ≥ 12**
 - **Screening criteria met (value = 18/16)**

– **Problem Statement**

- **Inaccessible or underground cables within the scope of Maintenance Rule are subjected to environments they are not designed or qualified for.**
- **Inaccessible or underground cables within the scope of Maintenance Rule are not being monitored by the licensees to demonstrate that the cables can perform their design functions when called upon.**



Regulatory Basis

NRC regulations require that cables be able to perform their design function when subjected to anticipated environmental conditions, such as moisture, flooding, heat, and radiation. Further, the design should minimize the probability of power interruption when transferring power between sources. The cable failures that could disable safety-related or risk-significant equipment are expected to have monitoring programs to demonstrate that the cables can perform their design function when called upon.



Regulatory Requirements

- 10 CFR Part 50, Appendix A, General Design Criterion (GDC) 2, “Design Bases for Protection Against Natural Phenomena.”
- 10 CFR Part 50, Appendix A, General Design Criterion (GDC) 4, “Environmental and Dynamic Effects Design Bases.”
- 10 CFR Part 50, Appendix A, GDC 17, “Electric Power Systems.”
- 10 CFR Part 50, Appendix A, GDC 18, “Inspection and Testing of Electric Power Systems.”
- 10 CFR 50.65(a)(1), “Maintenance Rule.” 10 CFR 50.49, “Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants.”
- 10 CFR 50.49, “Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants,
- 10 CFR Part 50, Appendix B, Criterion III, “Design Control.”
- 10 CFR Part 50, Appendix B, Criterion V, “Instructions, Procedures, and Drawings.”
- 10 CFR Part 50, Appendix B, Criterion XI, “Test Control.”
- 10 CFR Part 50, Appendix B, Criterion XVI, “Corrective Actions.”

Technical Basis

- Electric cables are one of the most important components in a nuclear plant to provide the various plant systems function to mitigate the effects of an accident and preserve the safety of the plant during normal, abnormal, and anticipated operational occurrences.
- If cable degradation from aging or other mechanisms remain undetected, it can lead to deterioration of cable performance or result in cable failure when it is relied on to mitigate design bases accidents and transients.
- In response to Generic Letter 2007-01, licensees provided data showing that the number of cable failures is increasing with plant age, and that cable failures are occurring within the plants' 40-year licensing periods. These cable failures have resulted in plant transients and shutdowns, loss of safety redundancy, entry into limiting conditions for operation, and undue challenges to plant operators.
- The staff's safety determination during plant licensing was based on licensees meeting the regulatory requirements cited above to ensure that components such as cables will perform its design functions during the design bases events.

Staff Positions

- **Inaccessible or underground** cables within the scope of the Maintenance Rule should be monitored by the licensees at an appropriate frequency to demonstrate that the cables can perform their design functions when called upon.
- **Inaccessible or underground** cables must be designed to meet its intended design function for the environment that they are subjected to. If cables have been exposed to conditions for which they are not designed or qualified, the licensees must demonstrate, through adequate testing or condition monitoring, that the cables can perform their intended design function for the duration of the qualified period.



Generic Communications

- **Information Notice 1989-63: Possible Submergence of Electric Circuits Located Above the Flood Level Because of Water Intrusion and lack of Drainage**
- **Information Notice 2002-12: Submerged Safety-Related Electrical Cables (ADAMS Accession No. ML020790238)**
- **GL 2007-01: Inaccessible or Underground Power Cable Failures that Disable Accident Mitigation Systems or Cause Plant Transients (ADAMS Accession No. ML070360665).**
- **SUMMARY REPORT: Generic Letter 2007-01, “Inaccessible or Underground Power Cable Failures That Disable Accident Mitigation Systems or Cause Plant Transients” (ADAMS Accession No. ML082760385)**



Inspection Findings

The NRC inspection reports for the last 10 years identified cable performance issues at various facilities. It identified violations of NRC regulations 10 CFR 50, Appendix B, Criterion III, “Design Control,” Criterion V, “Instructions, Procedures, and Drawings,” Criterion XI, “Test Control,” Criterion XVI, “Corrective Actions,” 10 CFR 50.65, “Requirements for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants,” and other performance issues (Green/White findings).



Resolution - Staff Recommendations

- Licensees must be in full compliance with NRC regulatory requirements specified above for cable systems.
- If cable systems (i.e., cables, splices, connections, trays, supports, enclosures, etc.) have been exposed to conditions for which they are not designed or qualified, licensees must demonstrate qualification for the plant-specific application. Licensees then must demonstrate, through adequate testing or condition monitoring, that the cable systems can perform their intended design function for the duration of its expected service life.
- Nuclear industry to develop and implement a cable monitoring program to comply with Commissions regulatory requirements.
- NRC verifies licensees' implementation through routine Baseline inspections.
- Issue a NUREG report that identifies the essential elements for a cable condition monitoring program.
- Issue a Regulatory Guide that provides guidance for maintaining the cable qualification and verifying that the cables can perform their design functions when called upon.